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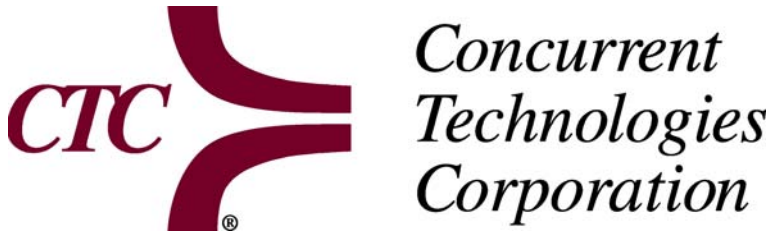


Transportation Capacity Planning:
A Five-day Horizon to the Last Tactical Mile

Norman L. Reitter, Principal Logistics Engineer
Donald Spidahl, Senior Logistics Specialist
Captain Eric Wolf, USMC, Logistics Operations Analyst
Captain Bryan Hatfield, USMC, Logistics Operations Analyst

June 21, 2005

Presentation Agenda

- Stakeholders
- Problem Definition
- Approach for Development and Analysis
- Observations

Stakeholders

- Coordinated by USMC Headquarters
  - **LtCol Robert Rackham, Technical Point of Contact**
  - Logistics Capabilities Center
    - **Mr. Steve Thien, Distribution Branch Head**
  - Logistics Studies and Analysis
    - **Capt Eric Wolf,**
    - **Capt Bryan Hatfield**

- Stakeholders in the Marine Forces
  - **I, II, and III Marine Expeditionary Forces**
  - **Marine Forces Reserve**

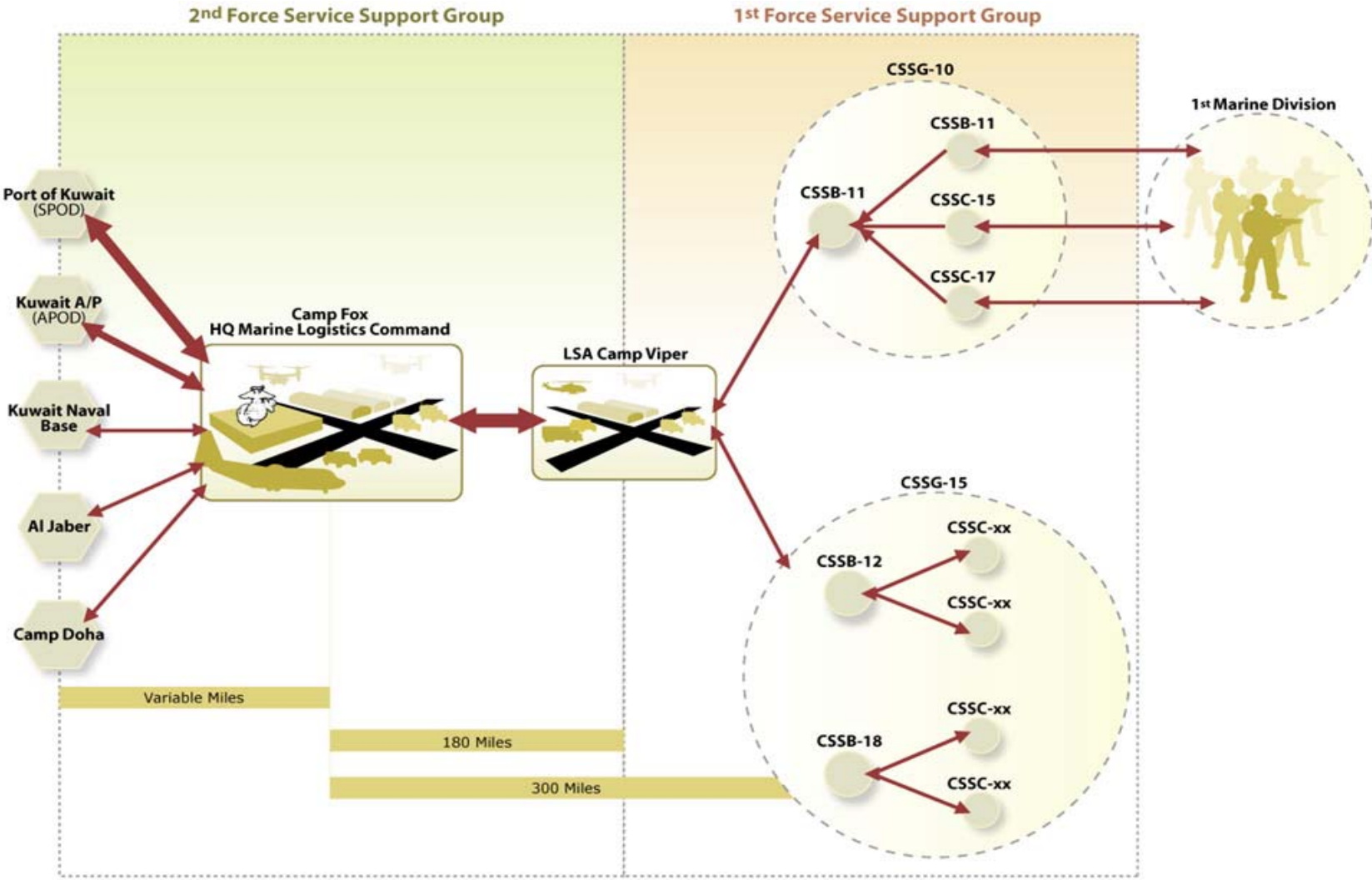
- Managed and Executed by Concurrent Technologies Corporation (*CTC*)
  - **Mr. Norm Reitter, Project Manager**

TCPT: An Innovation from the Expeditionary Warfare Logistics Testbed

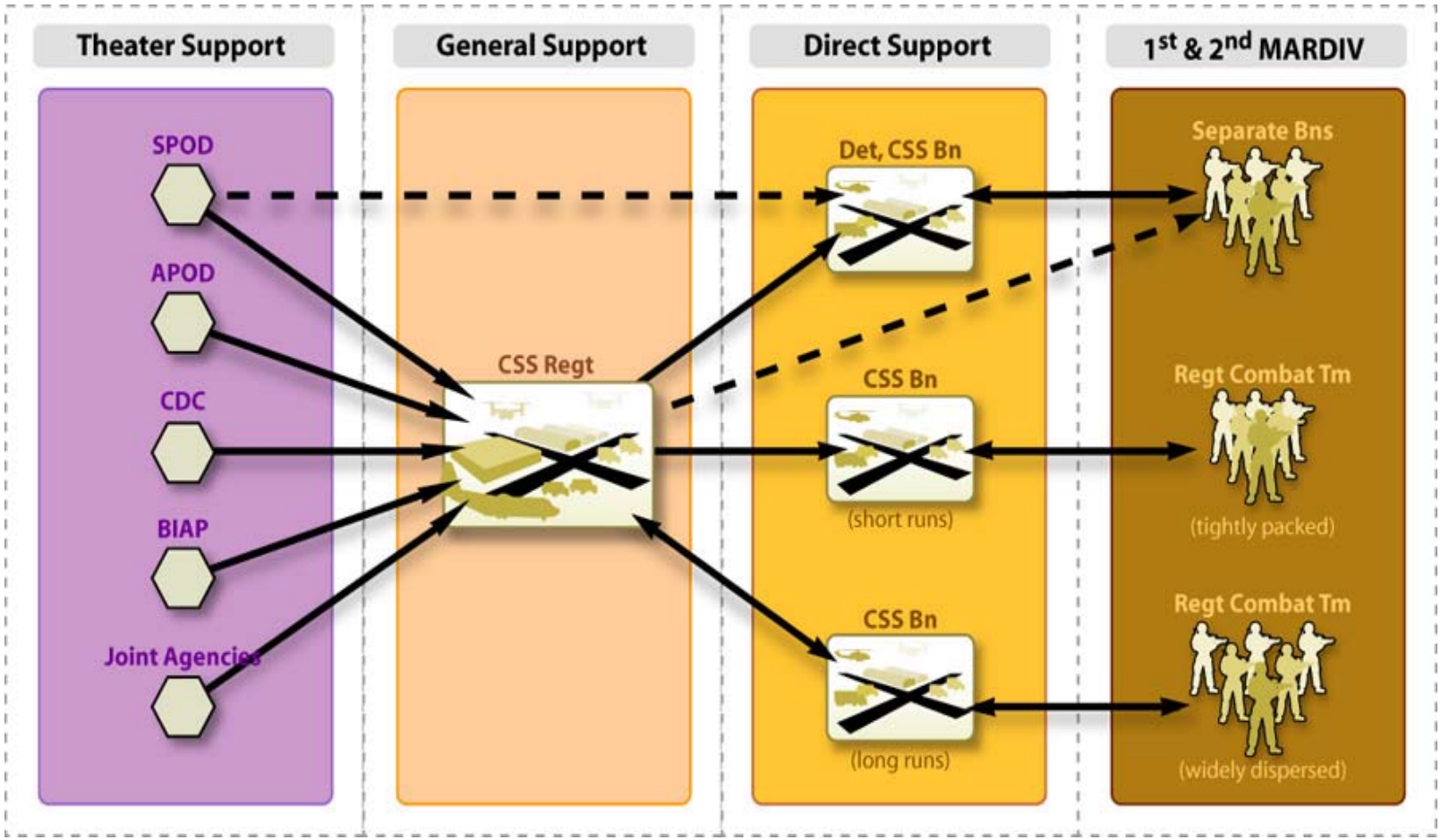
- The Expeditionary Warfare Logistics Testbed (EWLT) Initiatives
  - Refines future planning capabilities through prototype development and assessment in an Applied Research & Development (AR&D) environment
  - Supported by a Web-enabled application for collaboration (http://ewlt.ctc.com)

- The Transportation Capacity Planning Tool (TCPT)
  - Represents first prototype developed as an EWLT initiative
  - Provides online decision support for transportation planning application
  - Affords desired transportation capacity awareness and planning over the USMC “last tactical mile”
  - Undergoing user validation in OIF

Distribution Network Characteristics Magnify the Transportation Problem Operation Iraqi Freedom I



Distribution Network Characteristics Magnify the Transportation Problem Operation Iraqi Freedom II & III



The USMC Transportation Planning Problem during OIF

- Transportation planning problems are not new

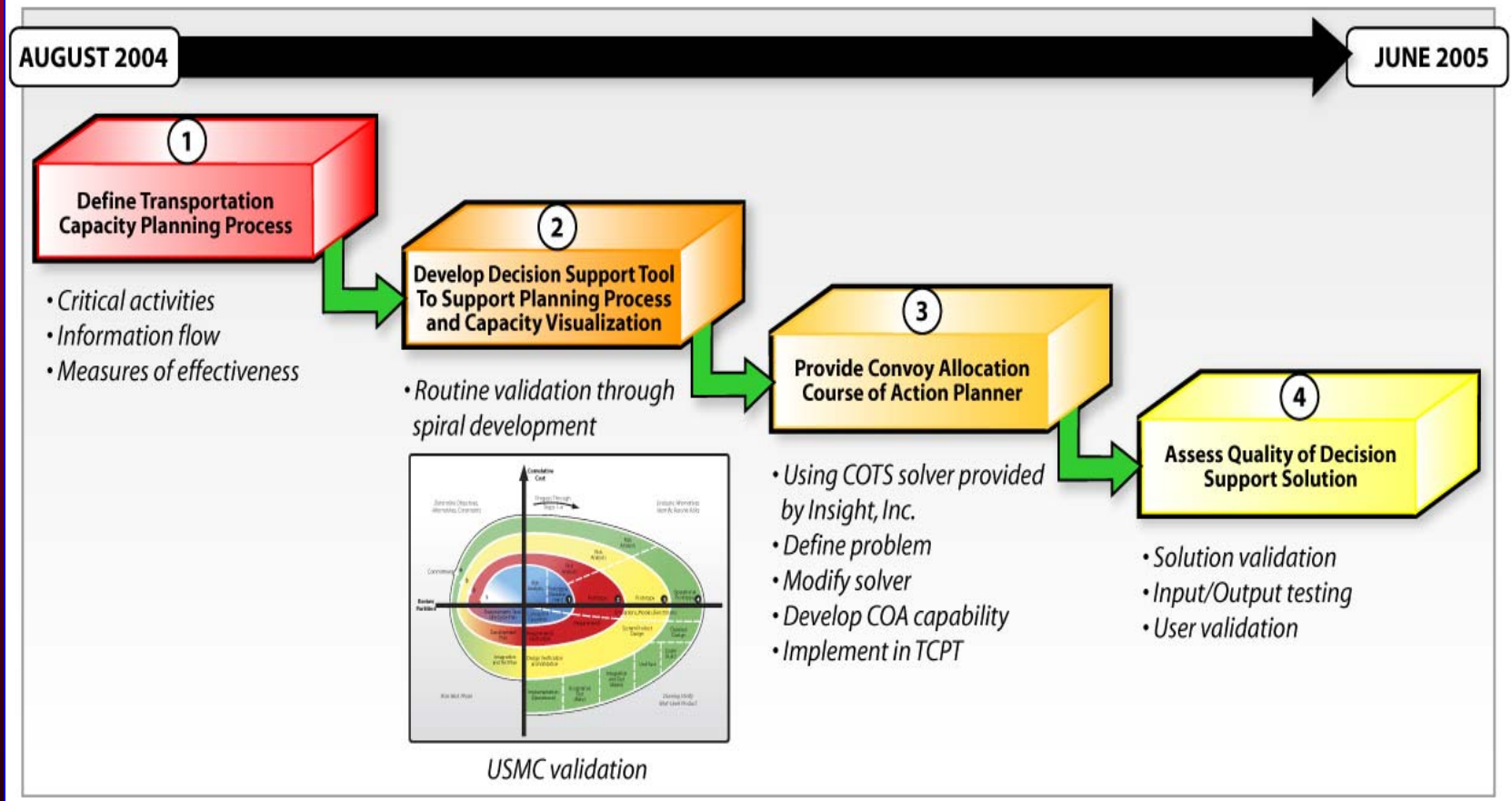
- The USMC experienced multiple transportation challenges during Operation Iraqi Freedom (OIF), including:
  - Inability to visualize capacity based on available resources and upcoming demands
  - Difficulty managing transportation taskers from initial entry through allocation and assignment, resulting in inability to make “capable to promise” determination
  - Lack of complete situational awareness of transportation resources through mission execution

- The USMC needed a near-term transportation capacity planning prototype to do the following:
  - Address an immediate need for improved awareness and planning
  - Gather feedback for future planning tool acquisition

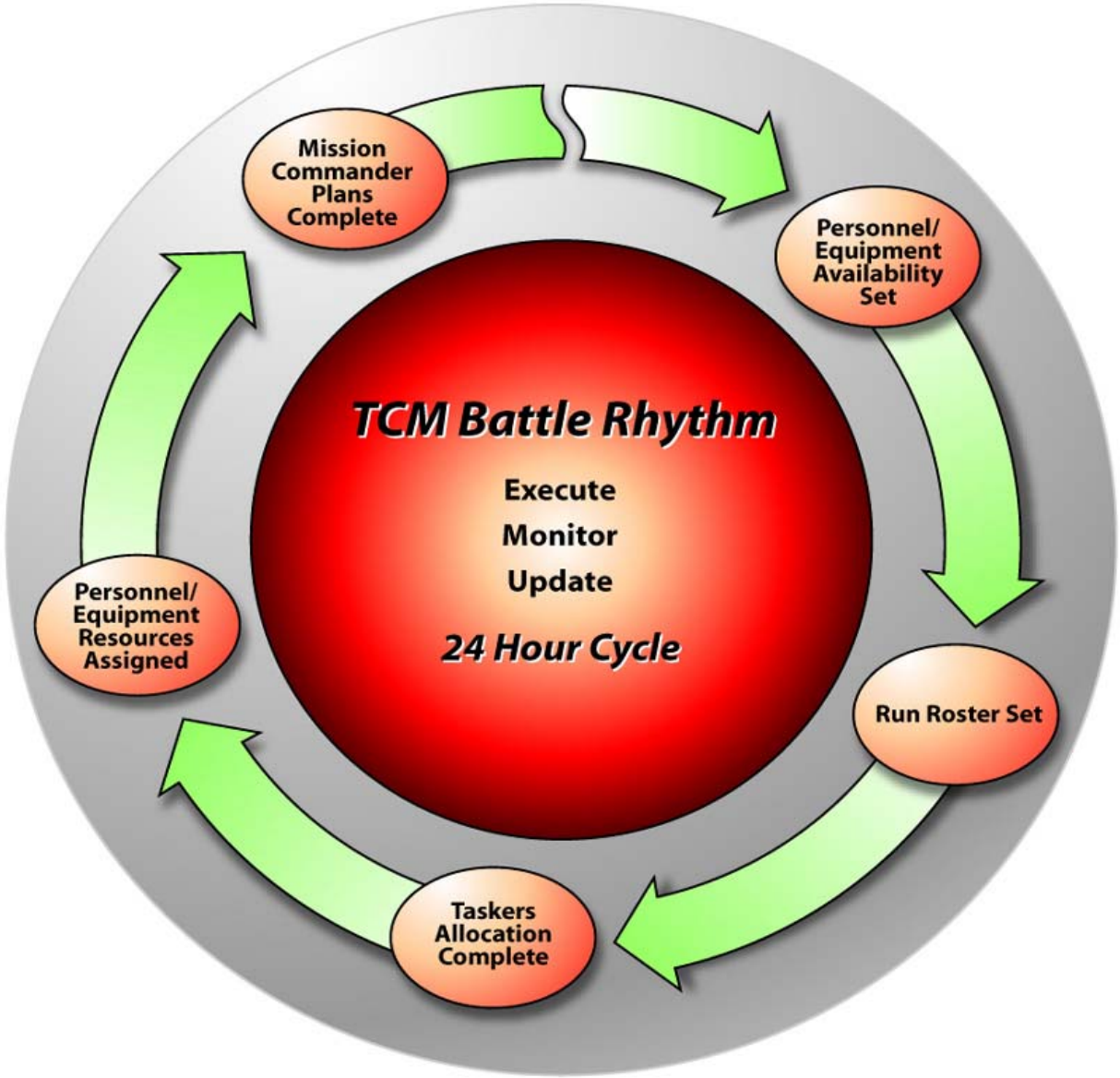
The Need for Enhanced Decision Support

- Improved **situational awareness** for Logistics Command and Control
  - View of capacity, resources, and mission status
- **Flexibility** to alter the plan and see the impact of overall planning quality
- Reduce **planning cycle time**
  - Increase the amount of planning time to improve “capable to promise” answers
- Increase **delivery reliability**
  - Ensure delivery dates and times are met at the desired location
- Increase **resource efficiency**
  - With a desired level of effectiveness

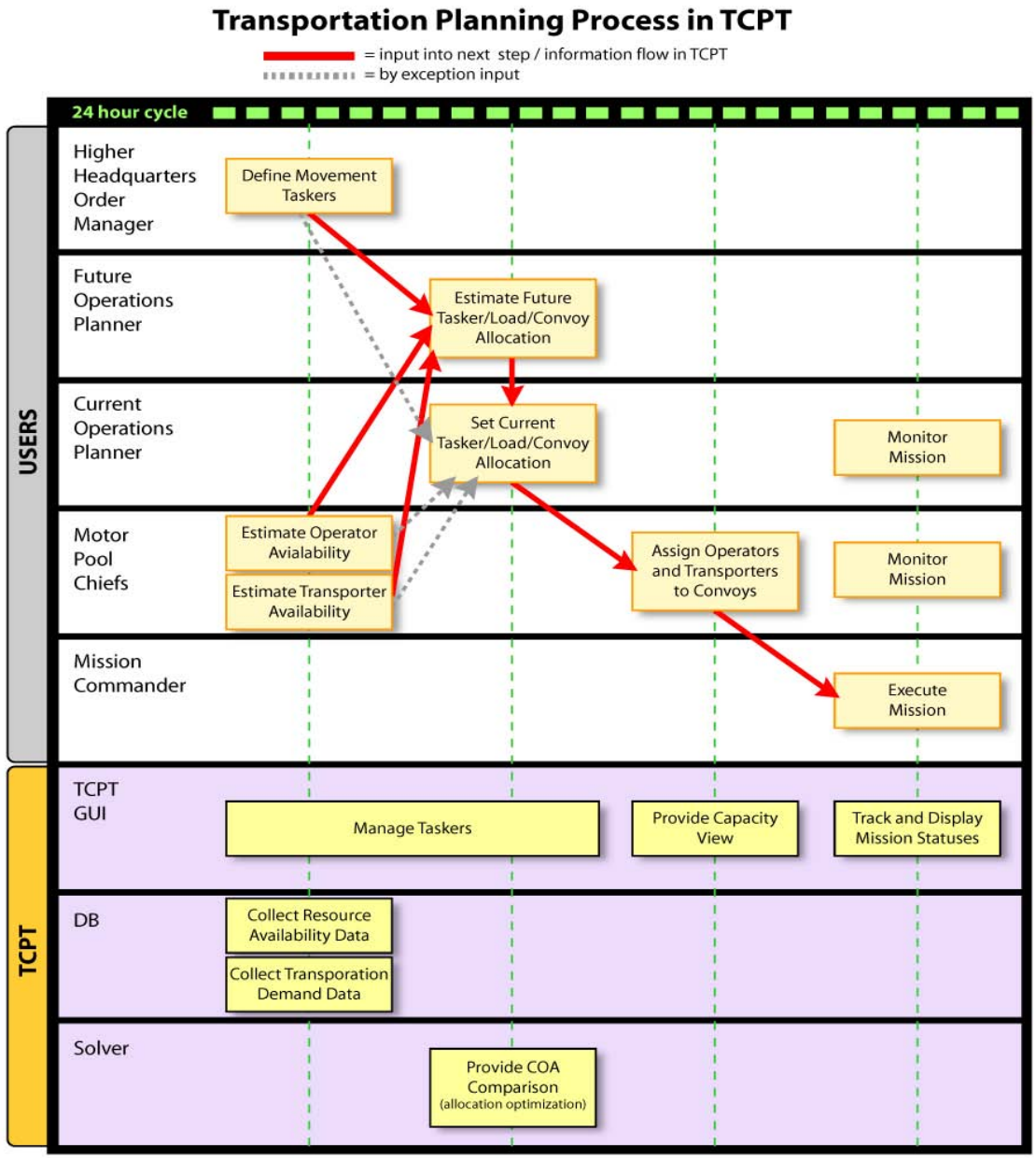
Approach for Development and Analysis



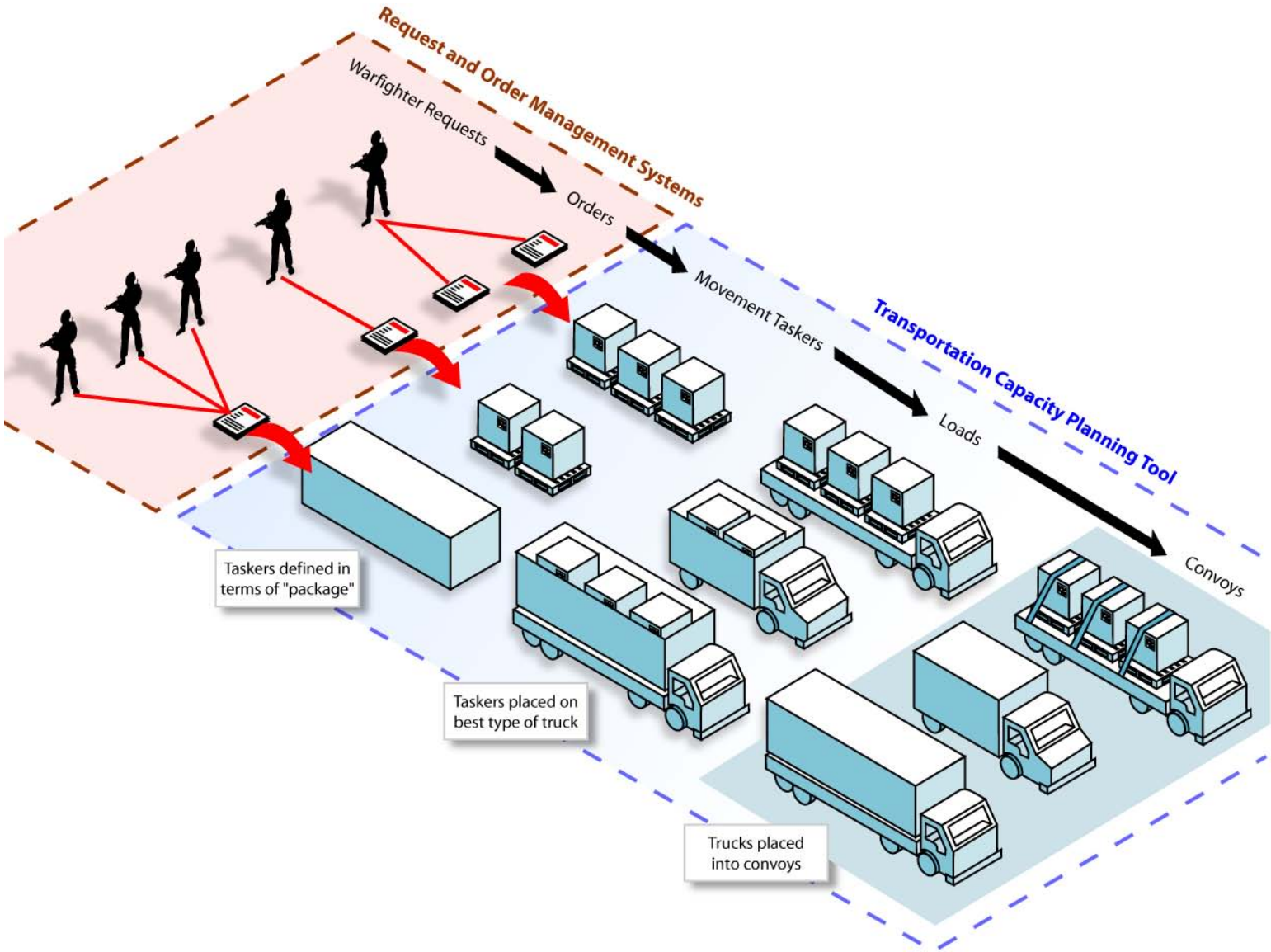
Transportation Planning Events



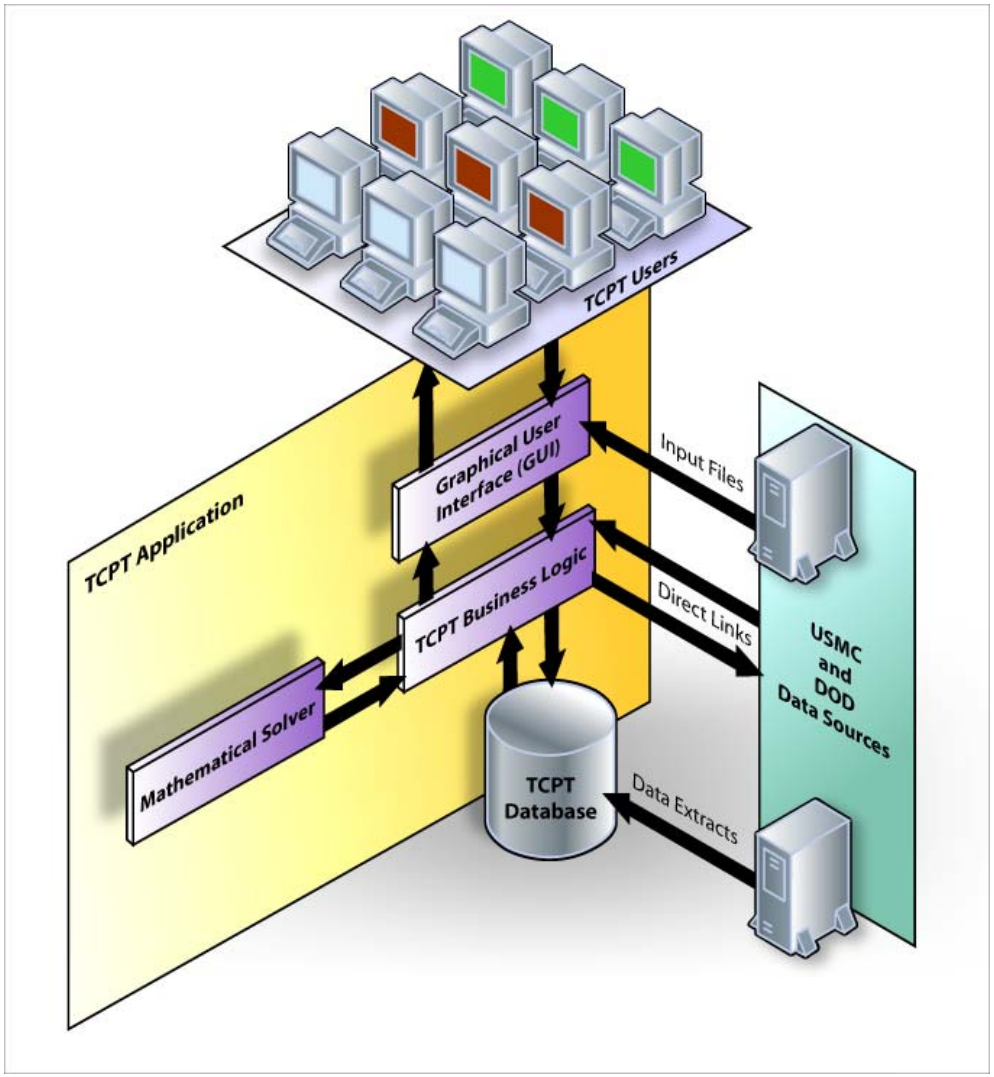
Transportation Planning Flow in TCPT



Information and Product Flow in TCPT



Transportation Capacity Planning Tool Components



TCPT Transportation Capacity Planning Tool

Welcome, 2nd FSSG User

Local Time: 14:48
Zulu Time: 19:48

2nd FSSG Personnel Overview

Unit	Daily Totals				
CSSD 25	126	119	119	126	119
CSSD 28	119	126	126	119	129
CSSD 29	126	119	119	126	119
Totals	371	364	364	371	364

2nd TSB Capacity Overview

Description	Daily Capacity				
On-Road ST					
Off-Road ST					
Quadcon					
ISO Containers					
463L Pallet					
Whse Pallet					
Fuel (On-Road)					
Fuel (Off-Road)					
Water (Bulk)					
Water (Unit)					
Troop Movement					
5k Lifts_HR					
10k Lifts_HR					
7.5 Ton					
25 Ton					
ISO Lifts					

Network Status

NIPRnet	
SIPRnet	
Cell	
Tactical Phone	

Add Entry | Search

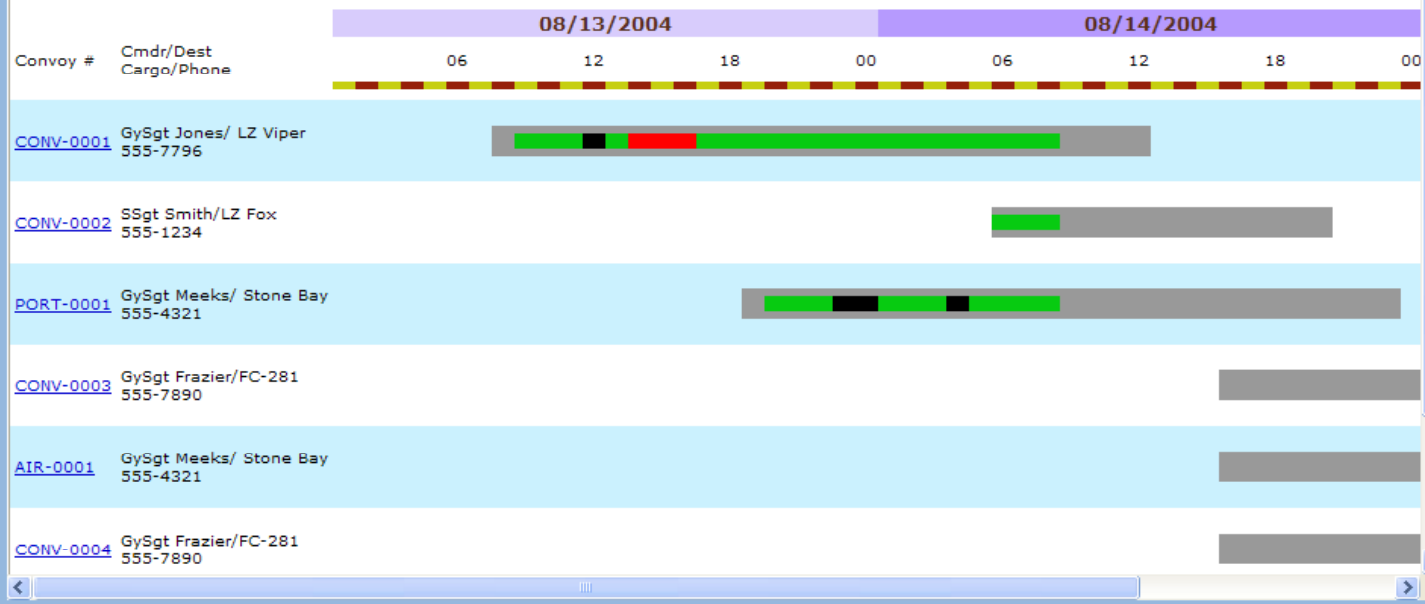
WatchLog

Mission Tracker

Date	ZULU Time	Comment	Entered By
08/13/2004	17:45	Taskers acknowledged by Alpha Company	System
08/13/2004	17:43	Taskers Acknowledged by Charlie Company	System
08/13/2004	17:30	HST has departed LZ Phoenix to conduct lifts with HMM-365	Cpl. Huffman
08/13/2004	17:25	Run Roster commited by S-3 Watch Chief. Ready for Company review.	System
08/13/2004	17:05	Convoy CONV-1234 under fire	LCpl. Binotz
08/13/2004	17:00	Port Op PORT-8765 reports arrival of ship delayed due to weather.	Ssgt. Smith
08/13/2004	16:55	Run Roster planning phase complete. Ready for S-3 Watch Chief review.	System
08/13/2004	15:45	Convoy CONV-1234 has departed for LZ Viper	SSgt. Sanders
08/13/2004	13:05	Tasker #4569 REJECTED by TSB Watch Clerk	System
08/13/2004	13:05	Tasker #4565 REJECTED by TSB Watch Clerk	System

Priority Mission Tracker

Mission Tracker | Legend | Mission Archive | Add New Mission



Convoy Allocation Problem

- The objective is to minimize total equipment distance driven over the planning horizon determined by the input tasker set.

- The solver considers physical and policy constraints, including:
  - Tasker source and destination
  - Time windows
  - Tasker priorities
  - Minimum and maximum number of vehicles per convoy
  - Minimum and maximum number of convoys allowed in plan
  - Maximum distances, times, and stops per convoy
  - Route distances and times
  - Unload times

Convoy Allocation Planner Solution

1. Read taskers, equipment availability, solver parameters from the user-defined scenario
2. Conduct work/balance summary
3. Determine equipment allocated to each tasker
4. Build “least-cost” convoy plan
5. Allocate equipment and sources to convoys
6. Generate output to TCPT
7. Evaluate convoy utilization and seek to improve load utilization within convoys
8. Display course of action (COA) for user assessment, solve again, if needed, and follow with resource assignment

Convoy Allocation Planner Evaluation

- Understand user input issues and impact of Commercial-Off-the-Shelf (COTS) solver limitations on back-end solution enhancements
- Assess how tasker packaging definition impacts percent utilization based on solver output
  - Less than truckload vs. truckload taskers
- Assess the impact of time and distance costs on solution results
- Determine the impact of minimum and maximum convoy sizes for on-time deliveries and overall road times
  - Minimum convoy size input {1, 15, 25, 50, 75}
  - Maximum convoy size input {25, 50, 75, 100, 125}

Results

- Tasker packaging definition does impact convoy and load utilization
- Time and distance costs have little impact on solution output
- Lowest combined total on-the-road hours and number of vehicles observed with minimum convoy size of 50 and maximum size of 100

Next Steps

- Expand user base to all elements of I, II, III Marine Expeditionary Forces and the Marine Reserves for full evaluation
- Automate information feeds to extend transportation planning horizon
- Collect feedback on functional planning needs for rapid planning tool prototyping and assessment
- Improve decision support for distribution planning as identified by operational need and determined by acquisition plan

Observations

- AR&D provides substantial near-term benefits for the warfighter, while helping to reduce risk of future acquisitions.
- COTS advanced planning tools and techniques have a significant potential to harness the flow of information and improve inputs into the logistics planning process.
- Warfighter input is critical to successfully applying modeling and simulation tools for logistics decision support.
- The government should fully assess COTS modeling and simulation technology in an AR&D operational environment before acquiring “out-of-the-box” solutions.

TCPT Demonstration Points of Contact

HQMC LX Points of Contact

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hatfieldbc@hqmc.usmc.mil

CTC Points of Contact

reittern@ctc.com

spidahld@ctc.com

Questions?

$$\sum_{s \in S_w} y_s + \underline{\omega}_w - \overline{\omega}_w = 1, \forall w \quad (1)$$

$$\underline{CONVOY}_c \le \sum_{s \in S_c} y_s + \underline{\chi}_w - \overline{\chi}_w \le \overline{CONVOY}_c, \forall c \quad (2)$$

$$y_s \in \{0,1\}, \forall s \quad (3)$$

$$\underline{\omega}_w, \overline{\omega}_w \ge 0, \forall w$$
$$\underline{\chi}_w, \overline{\chi}_w \ge 0, \forall c \quad (4)$$

Minimize

$$\sum_s \mathrm{COST}_s y_s + \sum_w (\underline{WP}_w \underline{\omega}_w + \overline{WP}_w \overline{\omega}_w) + \sum_c (\underline{CP}_c \underline{\chi}_c + \overline{CP}_c \overline{\chi}_c) \quad (5)$$